Re-architecting Data Platform with Kubernetes

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DEVSISTERS

- Mobile Game Publisher: including **Cookie Run Series**
- 10+ Million App Downloads, 2M+ Monthly Active Users

"Creating the Best Player Experiences through Excellent Content, Service, and Technology!"
"탁월한 기술, 서비스, 콘텐츠로 전 세계 고객에게 최고의 경험을 선사합니다."

Who am I?

SeungYong Oh (오 승 용)

- DevOps & Data Engineer at Devsisters
  - Also worked as a game server developer for Cookie Run series
- Kubernetes user from 2016
  - Adopted Kubernetes for development/testing environment for Cookie Run OvenBreak
    - NDC 2017: Kubernetes로 개발서버 간단히 찍어내기
      https://www.slideshare.net/seungyongoh3/ndc17-kubernetes

Kubernetes @ Devsisters

- 2014~2015: Proof-of-Concept level evaluation
- 2016: **Dev/testing environment game infra** for **Cookie Run: OvenBreak**
- 2017~: Dev/testing environment **game infra platform**
- 2019~: **Production-level game infra platform**
    - Cookie Run for Kakao, Hello Brave Cookies
- 2019~: **Data Platform** on Kubernetes
    - **Still ongoing**

Data Platform @ Devsisters

- Central logging infra with various data sources

Using those logs,

- Search
  - Search server/client logs for debug or operational purpose
  - Search specific user's action logs for customer service purpose
- Applications
  - A/B Testing, Machine Learning, ..
- And of course, Analytics!

Data Platform @ Devsisters

- Analytics: Analytics for Everyone!
  - Everyone?
    - Not only limited to data scientist, analyst
    - CEO, Project Manager, Marketer, Game Designer, ...
  - KPI(Key Performance Indicator) Service: Active users, Revenue, Retention,..
  - Ad-hoc query/analytics environment
    - Fully programmable environment for Data Scientist / Engineer
    - SQL query / clickable interface for many users

Data Platform @ Devsisters

Server Logs
k8s Pod / Docker /
Host syslog

Game Client / Web /
3rd Party Logs
(via custom SDK/API)

APACHE kafka
A distributed streaming platform

Apache Kafka /
Kafka Streams
Log collection
& pre-processing

Elastic Stack (ELK)
(Near) Real-time
Log Search & Analytics

Batch

Amazon S3
Data Lake

Analytics Infra / Service

APACHE Spark
Apache Airflow
jupyter

AWS Glue
Amazon Athena
Amazon QuickSight

$SOME_PROJECT_NAME supports K8S!

Many Big data & analytics related projects support Kubernetes in 2019!

- Hadoop, Spark, Airflow, Kubeflow, JupyterHub, Hue, Zeppelin, Superset, Kafka, Elastic Stack, etc.

Support?

- Case 1: (Official/Popular) Helm Chart
- Case 2: K8S Operator for the project
- Case 3: Cloud Native / Kubernetes-specific Integrations

But, does it mean we should move to K8S?

Many projects are stateful apps, especially in Big data / analytics

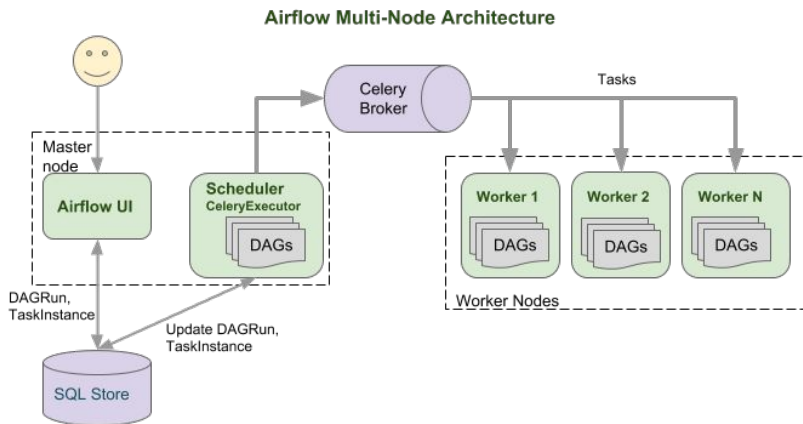
- Considerable risks / maintenance costs
    - Node Upgrade? Retirement? Reallocation is **NOT** easy
- Benefits?
    - Bin-packing? 🤔 (especially in public cloud)
    - Autoscaling? 🤔
    - Scheduling? 🤔
        - Already there are some advanced scheduler/resource manager (ex. Hadoop YARN)

Actually, there are some (great!) benefits!

Benefit #1: Deployment / Ops Made Easy

Example: Apache Airflow

Apache Airflow: Workflow Management tool

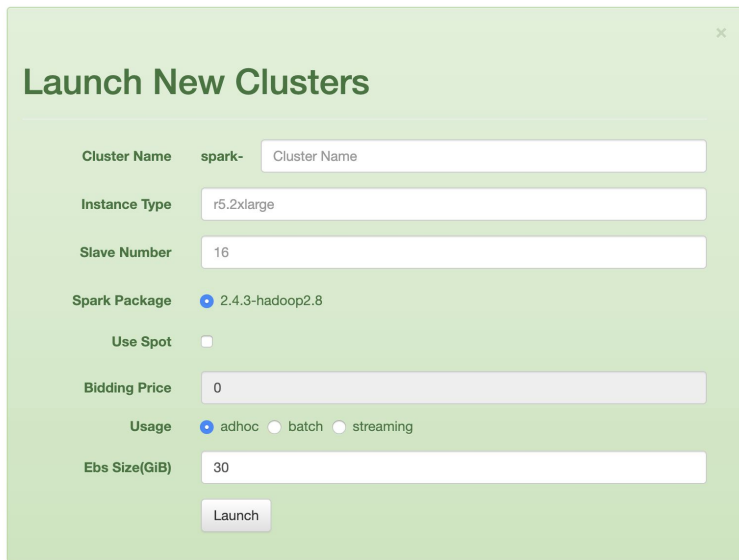
Source:
https://github.com/GoogleCloudPlatform/airflow-operator/blob/master/docs/design.md

Quick Deployment with

- helm install stable/airflow

or

- Airflow operator
  https://github.com/GoogleCloudPlatform/airflow-operator/

Benefit #2: Analytics - Easy and Efficient

Apache Spark @ Devsisters

A unified analytics engine for large-scale data processing

Use-cases of Spark @ Devsisters:

APACHE kafka
A distributed streaming platform

APACHE Spark
Case #1: Store Logs (Batch)

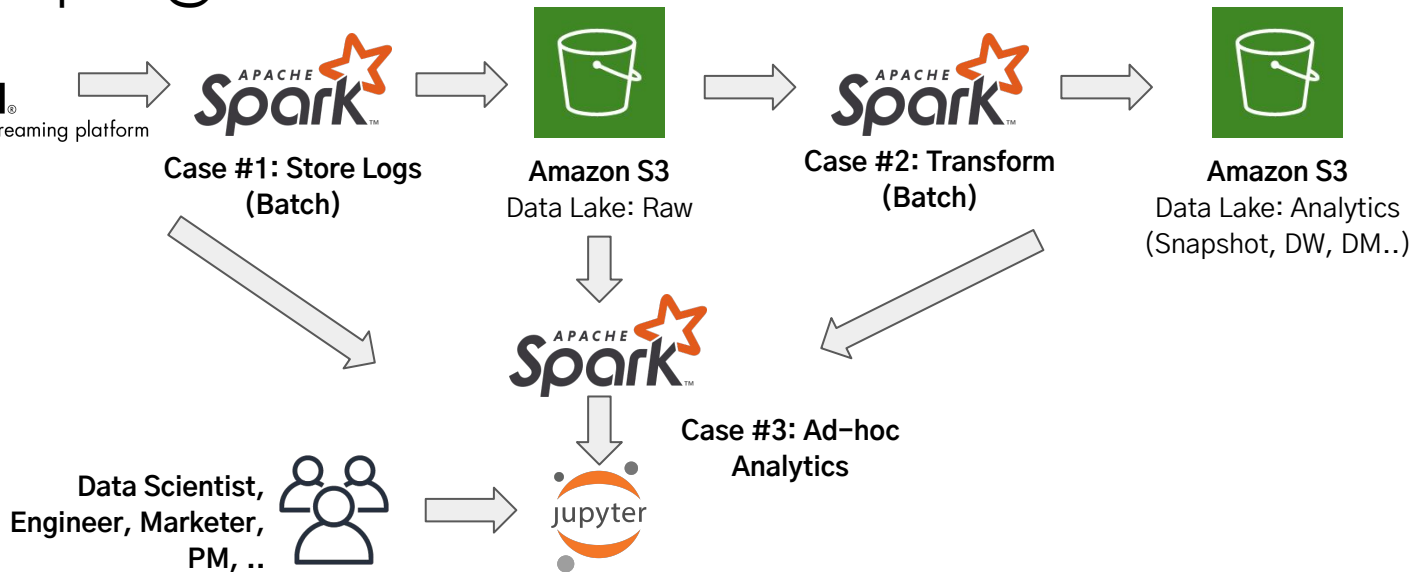
Amazon S3
Data Lake: Raw

APACHE Spark
Case #2: Transform (Batch)

Amazon S3
Data Lake: Analytics (Snapshot, DW, DM..)

APACHE Spark
Case #3: Ad-hoc Analytics

Data Scientist, Engineer, Marketer, PM, ..

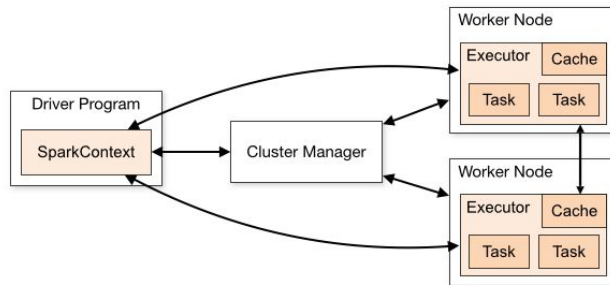
jupyter

Apache Spark @ Devsisters

Self-service web interface for Spark Cluster Provision

Launches Spark Cluster (standalone mode)

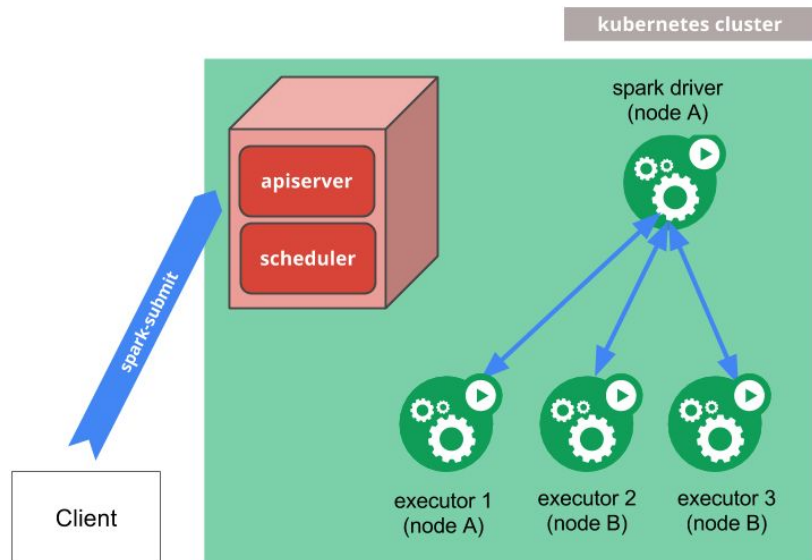
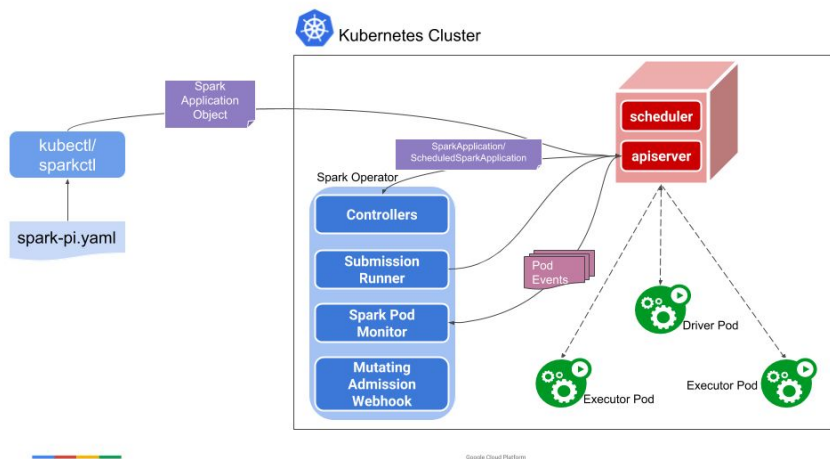
- 1 master node with Jupyter Notebook
- multiple worker nodes

https://www.slideshare.net/JPark0426/ndc-2018-spark-flintrock-airflow

Apache Spark @ Devsisters

So, anyone can have their own Spark Cluster with one-click! Looks Good?

- Many users (ex. Marketing Manager) only want to focus on data analysis!
  - r5.xlarge?
  - spot? bidding price?
  - Waiting few minutes for spark provisioning, with some failures
  - Should backup their files before terminating cluster
- Cost ineffective
  - idle resources
  - forget to terminate cluster after use

Then sharing a centralized cluster? NO! (access control issues etc.)

Spark on Kubernetes

K8S Operator for Apache Spark

https://github.com/GoogleCloudPlatform/spark-on-k8s-operator

Apache Spark - Native K8S Scheduler (experimental)

https://spark.apache.org/docs/latest/running-on-kubernetes.html

Jupyter + Spark on K8S

```
# Execute below in Jupyter Pod
PYSPARK_DRIVER_PYTHON=jupyter \
PYSPARK_DRIVER_PYTHON_OPTS='notebook --allow-root' \
./bin/pyspark \
      --master k8s://https://$KUBERNETES_SERVICE_HOST:$KUBERNETES_PORT_443_TCP_PORT/ \
      --name spark-$APP_NAME \
      --conf spark.executor.instances=$EXECUTOR_COUNT \
      --conf spark.kubernetes.container.image=<<custom built spark container>> \
      --conf spark.kubernetes.namespace=spark-test \
      --conf spark.kubernetes.authenticate.driver.serviceAccountName=spark-test-server \
      --conf spark.driver.host=spark-driver \
      --conf spark.driver.port=5555 \
      --conf spark.driver.bindAddress=0.0.0.0 \
      --conf spark.driver.blockManager.port=5556 \
      --conf spark.kubernetes.executor.annotation.iam.amazonaws.com/role=<<AWS IAM role (KIAM)>>
```

- But users need much easier interface!

JupyterHub + Spark on K8S

- Multi-user version of Jupyter Notebook, support k8s natively
- Launch a notebook pod per user
  - Data is persisted (stored in PersistentVolume)

- Let's Integrate Spark on K8S with JupyterHub !

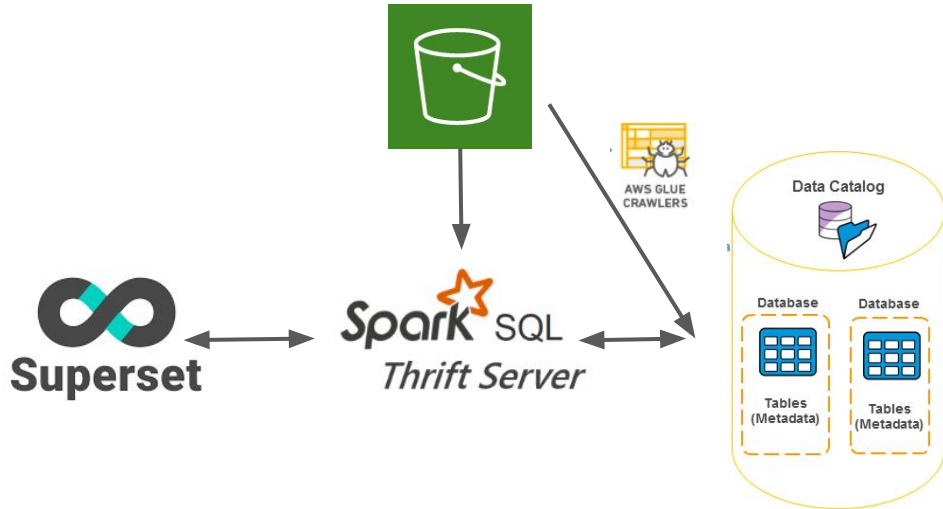
JupyterHub + Spark on K8S

- Demo

File Edit View Run Kernel Tabs Settings Help
TERMINAL SESSIONS
KERNEL SESSIONS
Untitled1.ipynb
SHUT DOWN
Untitled1.ipynb
Code
Python 3
[1]: spark
[1]: SparkSession - hive
SparkContext
Spark UI
Version v2.4.4
Master k8s://https://10.100.0.1:443/
AppName spark-app-jupyterhub-kimtkyeom
[ ]:
0 1 Python 3 | Idle
Mode: Edit Ln 1, Col 1 Untitled1.ipynb

But many users only need SQL interface

- Spark has distributed SQL Engine
  https://spark.apache.org/docs/latest/sql-distributed-sql-engine.html
  - Thrift JDBC/ODBC server (corresponds to the HiveServer2)

- Integration with Apache Superset (Business Intelligence web app)

Superset
Security
Manage
Sources
Charts
Dashboards
SQL Lab
Untitled Query
Database: sparksql spark_thrift_serve
Schema: sdkdemo_analytics_dev
See table schema (7 in sdkdemo_analytics_dev)
Select table or type table name
topic_platform
topic_game
latest partition: type=track/partition
app VARCHAR
context VARCHAR
env VARCHAR
event VARCHAR
fgsid VARCHAR
gamecode VARCHAR
level VARCHAR
logtype VARCHAR
message VARCHAR
messageid VARCHAR
SELECT DISTINCT(mid) FROM analytics_topic_analytics
WHERE type='identify' AND partition='login' AND date = '2019-11-18'
Run Query
Save Query
Share Query
LIMIT 1000
Results
Query History
Preview: `topic_platform`
Preview: `topic_game`
Explore
.CSV
Clipboard
mid
SQRBT0891
DDRLH5303
GNSRY2100

For applications?

- Example #1:
    - Send push messages to users that played game more than a hour yesterday
        - JDBC!
- Example #2:
    - Give special items to users that has some possibility not to play the game anymore
        - spark-submit?

Benefit #3: Fine-tuning Access Controls

Still Stressful but Easier

- Web Apps: Use Auth Proxy Sidecar
- For apps that don't support RBAC:
    - Pod-level data access control (S3 in Devsisters' case)
        - In AWS, with KIAM or AWS IAM Authenticator
    - Or Node-level (with nodeSelector)
    - Pods/Deployment per each group/roles + Benefit of Bin-packing

Then, Let's move to Kubernetes Now..?!

Still in Early Stage

- Spark on Kubernetes
    - Doesn't support dynamic allocation / external shuffle service yet
        - You can't change count of executors
    - Pod Templating - available on 3.0 Preview
        - Even You can't specify service account of executor pod now
- Other Many Projects also in alpha stage,
  which requires code-level modifications / forking
  to meet the team's requirements
- If storage & computing resource is coupled, maybe little more hard to move

But it's worth to move!

- A Data Engineer who doesn't have prior knowledge of Kubernetes could implement Spark on K8s/JupyterHub/Superset customizations less than 1.5 months (expected more than 4 months for non-k8s env)
- Kubernetes' abstraction allows users to focus on what they can do best